Figure 1A

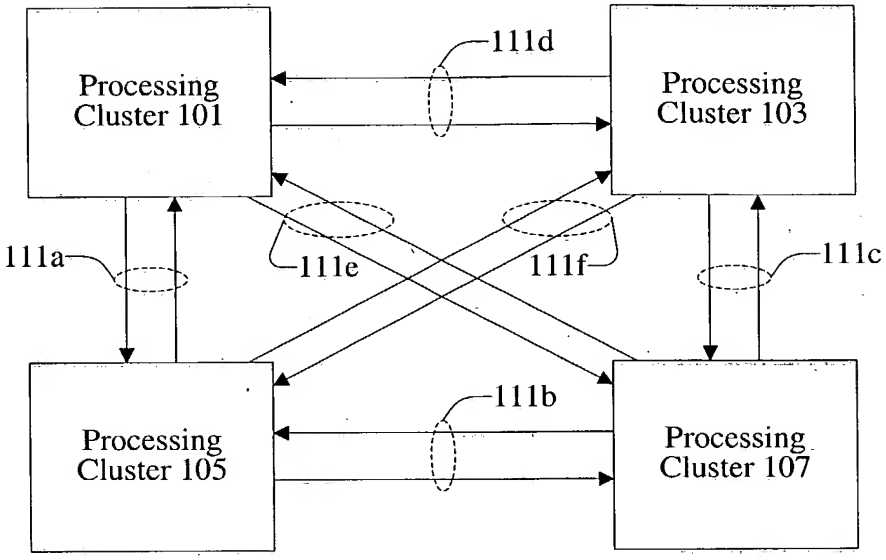


Figure 1B

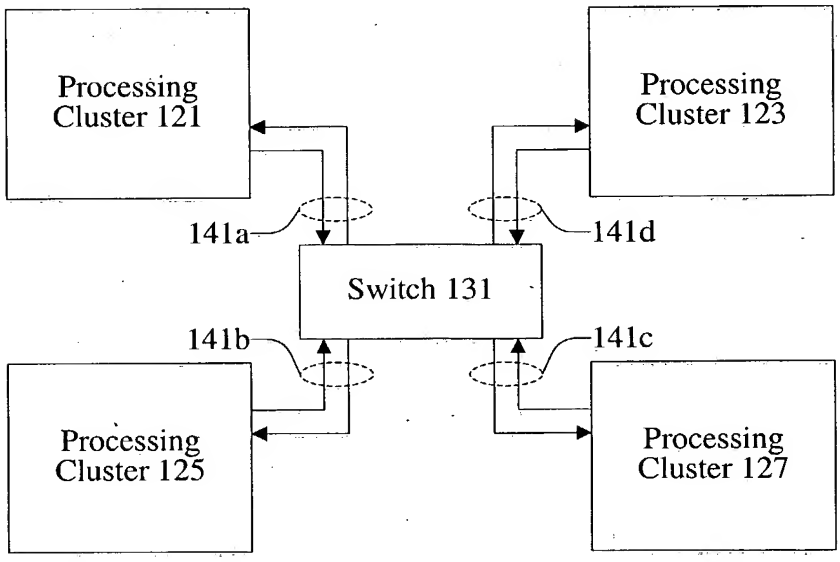


Figure 2

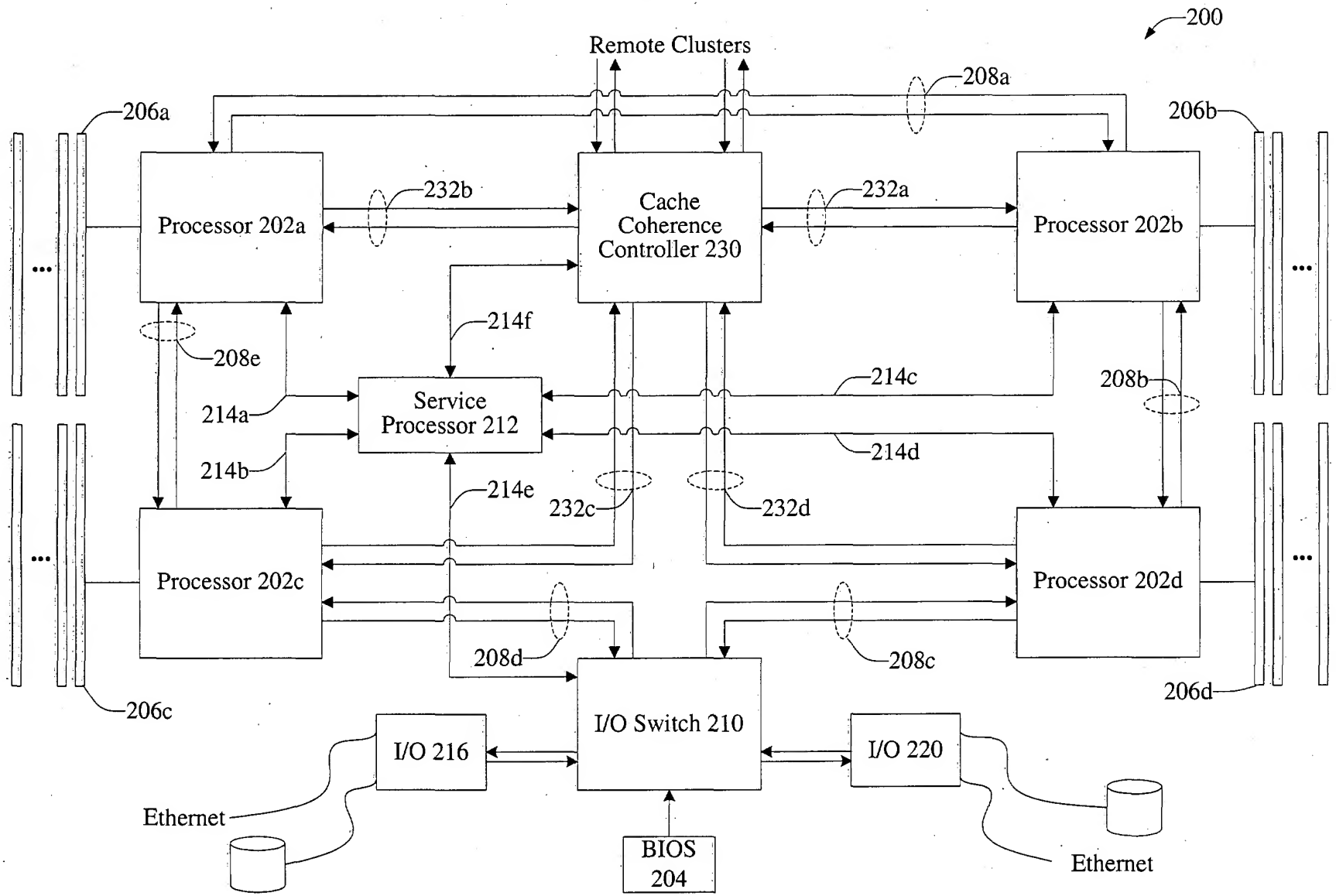

200
Remote Clusters
208a
206a
206b
Processor 202a
232b
Cache Coherence Controller 230
232a
Processor 202b
214f
208e
214a
Service Processor 212
214c
208b
214b
214d
214e
232c
232d
Processor 202c
Processor 202d
208d
208c
206c
206d
I/O Switch 210
I/O 216
I/O 220
Ethernet
BIOS 204
Ethernet

Figure 3

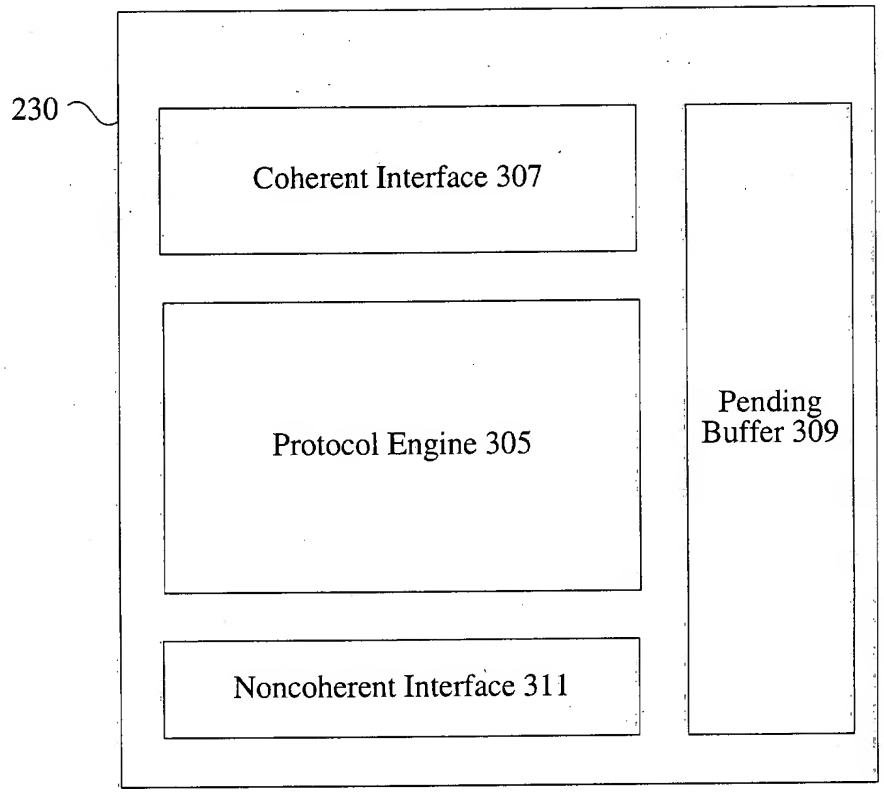

230
Coherent Interface 307
Protocol Engine 305
Noncoherent Interface 311
Pending Buffer 309

Figure 4

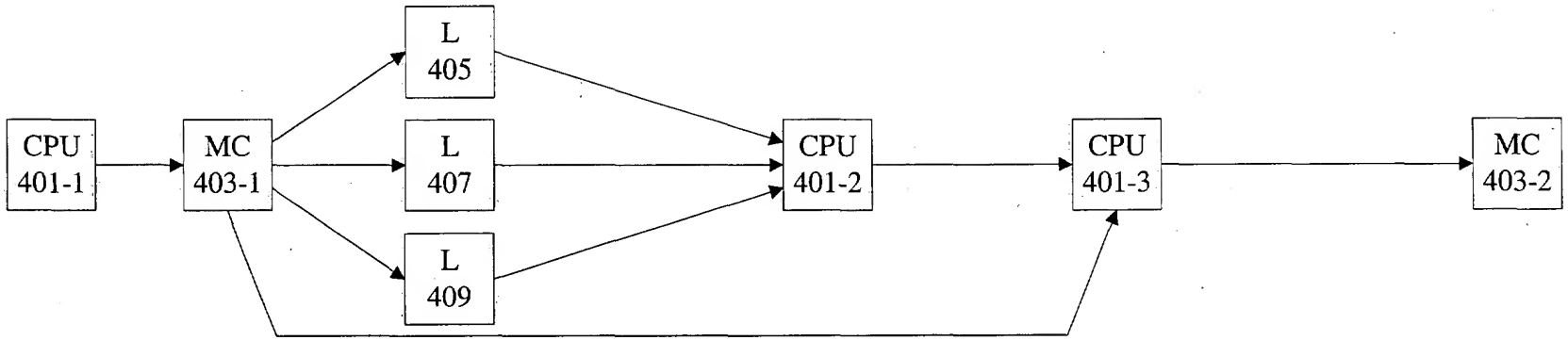


Figure 5A

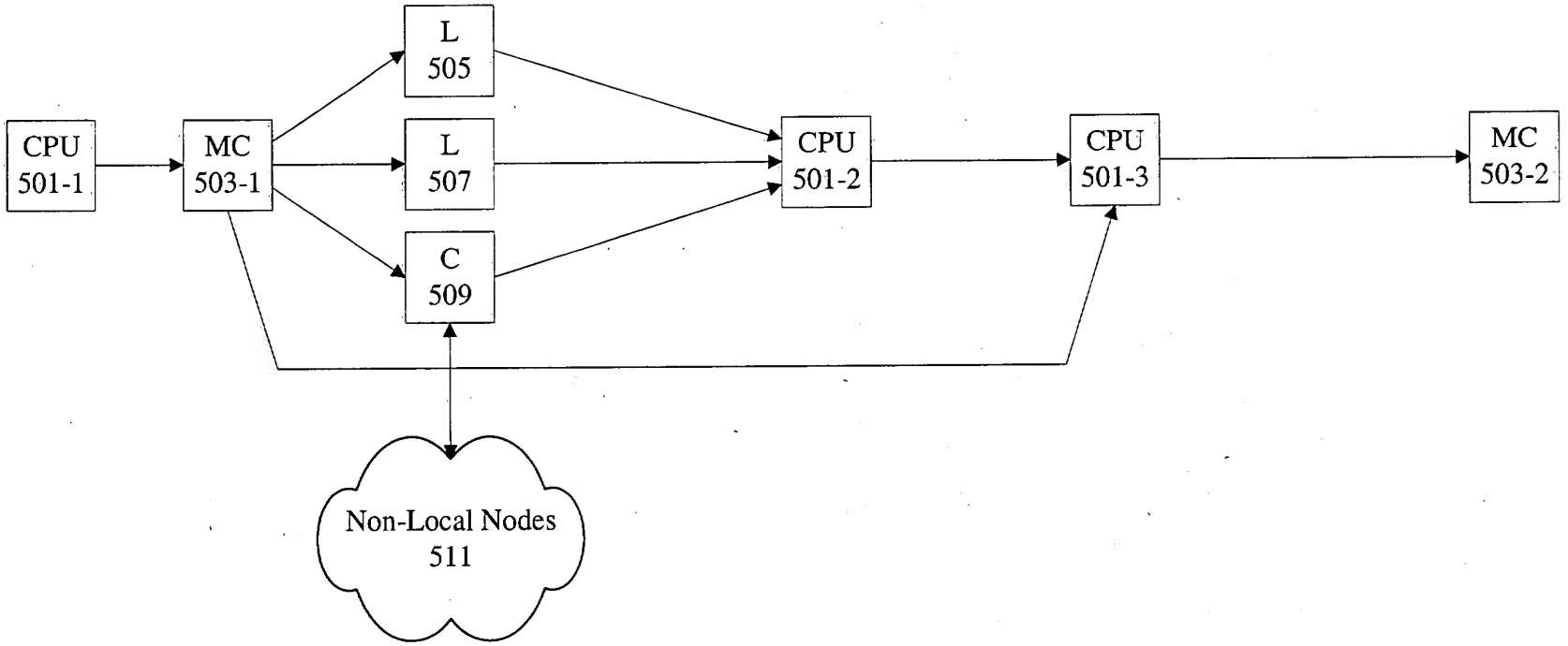

CPU
501-1
MC
503-1
L
505
L
507
C
509
CPU
501-2
CPU
501-3
MC
503-2
Non-Local Nodes
511

Figure 5B

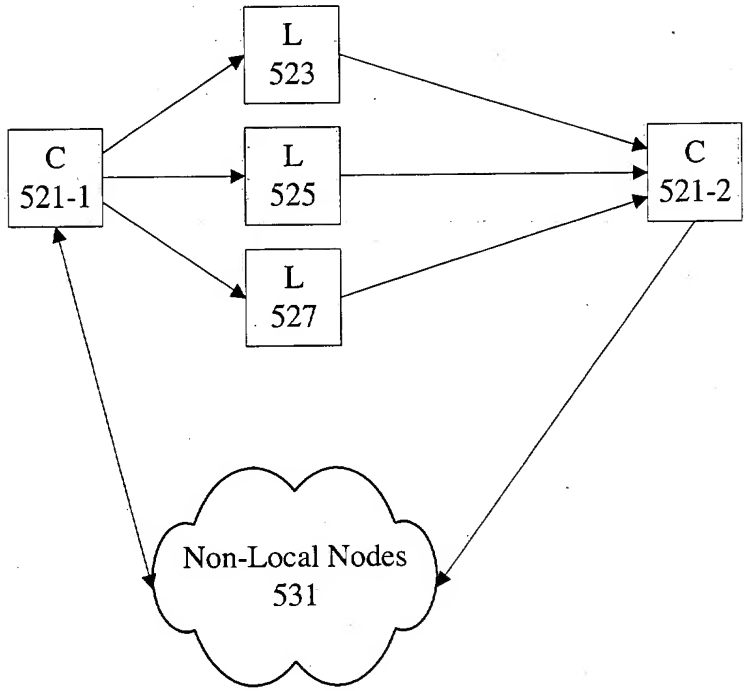


Figure 5C

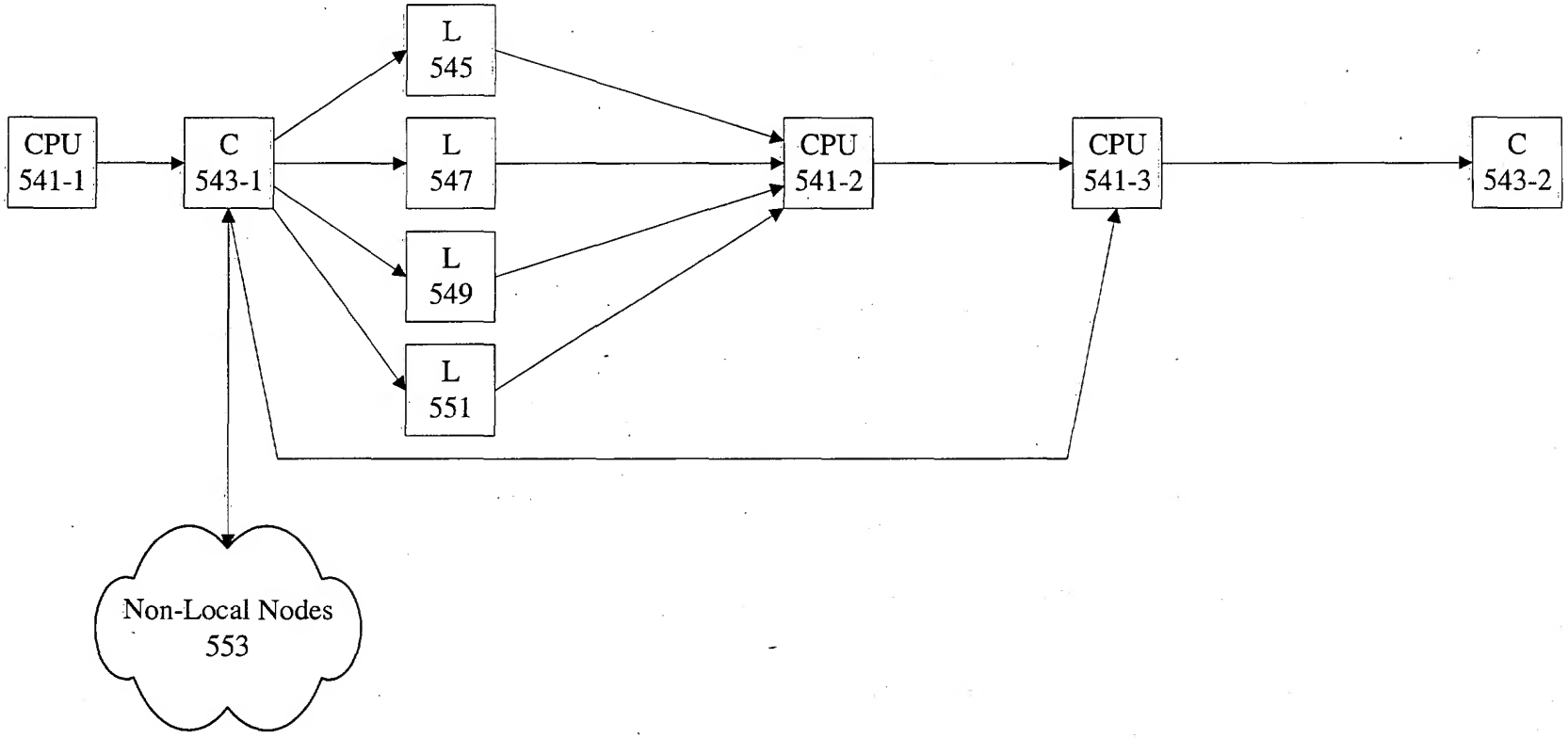

CPU
541-1
C
543-1
L
545
L
547
L
549
L
551
CPU
541-2
CPU
541-3
C
543-2
Non-Local Nodes
553

Figure 5D

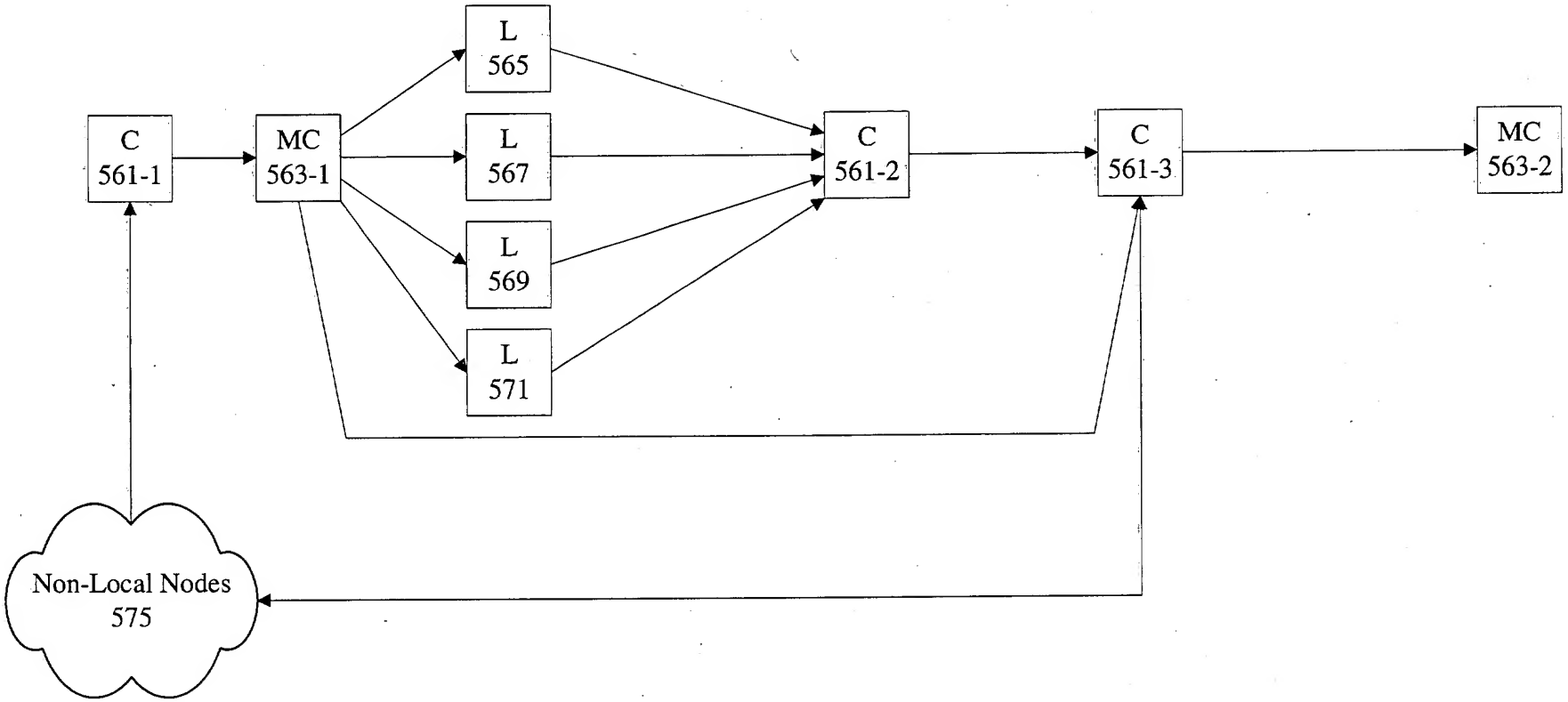

C
561-1
MC
563-1
L
565
L
567
L
569
L
571
C
561-2
C
561-3
MC
563-2
Non-Local Nodes
575

Figure 6

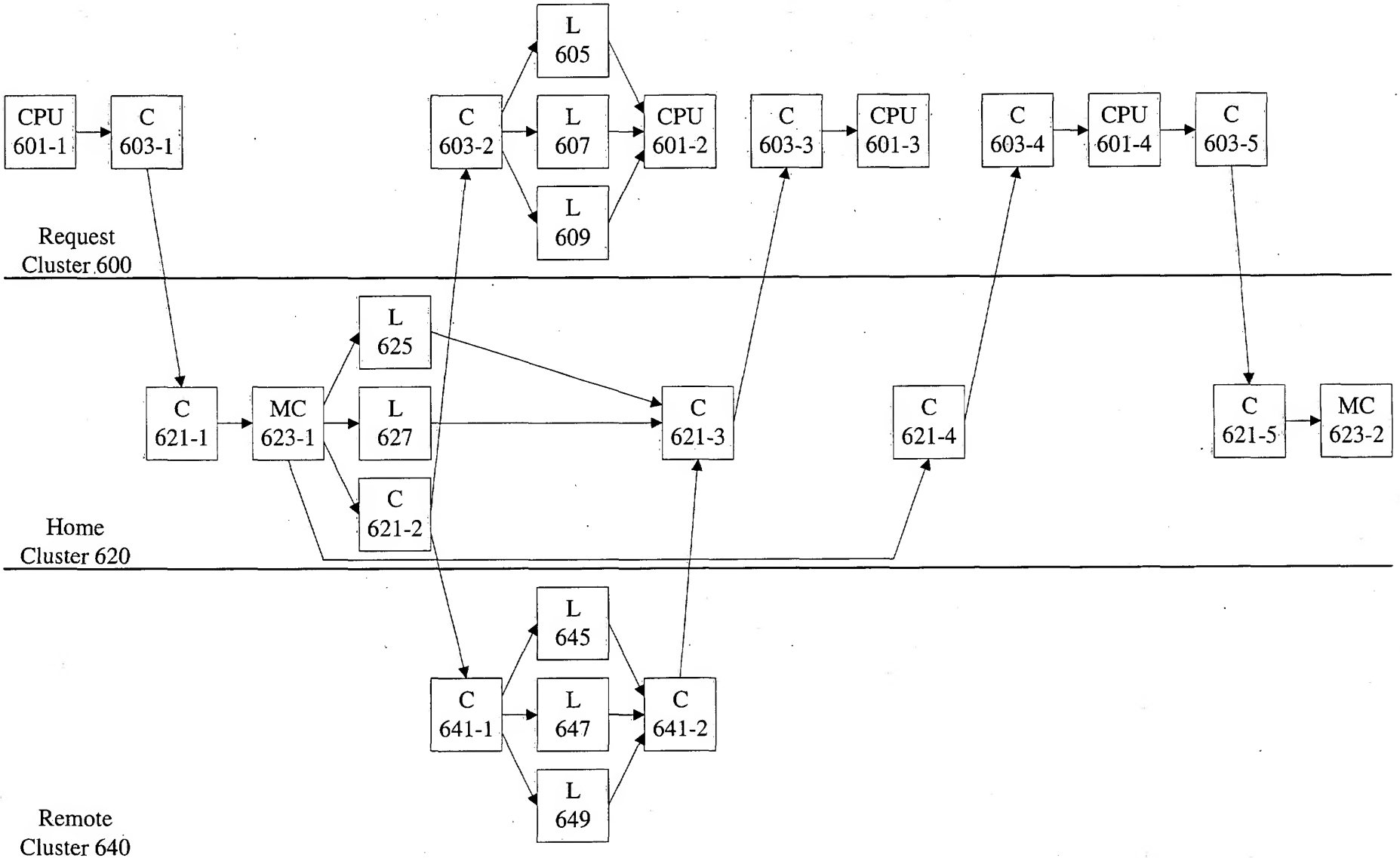

CPU 601-1
C 603-1
C 603-2
L 605
L 607
L 609
CPU 601-2
C 603-3
CPU 601-3
C 603-4
CPU 601-4
C 603-5
Request Cluster 600
C 621-1
MC 623-1
L 625
L 627
C 621-2
C 621-3
C 621-4
C 621-5
MC 623-2
Home Cluster 620
C 641-1
L 645
L 647
L 649
C 641-2
Remote Cluster 640

Figure 7

Coherence Directory 701			
Memory Line 711	State 713	Dirty Data Owner 715	Occupancy Vector 717
Address 721	Invalid	N/A	N/A
Address 731	Invalid	N/A	N/A
Address 741	Shared	N/A	Clusters 1,3
Address 751	Shared	N/A	Clusters 1, 2, 3, 4
Address 761	Owned	Cluster 4	Cluster 2, 3, 4
Address 771	Owned	Cluster 2	Cluster 2, 4
Address 781	Modified	Cluster 2	N/A
Address 791	Modified	Cluster 3	N/A
...	...	...	...

Figure 8

Coherence Directory 801				
Memory Line 811	State 813	Owning Cluster 815	Owning Node 817	Occupancy Vector 819
Address 821	Invalid	N/A	N/A	N/A
Address 831	Invalid	N/A	N/A	N/A
Address 841	Shared	N/A	N/A	Clusters 1,3
Address 851	Shared	N/A	N/A	Clusters 1, 2, 3, 4
Address 861	Owned	Cluster 4	Node 2	Cluster 2, 3, 4
Address 871	Owned	Cluster 2	Node 3	Cluster 2, 4
Address 881	Modified	Cluster 2	Node 1	N/A
Address 891	Modified	Cluster 3	Node 3	N/A
...	...	...	...	...

Figure 9

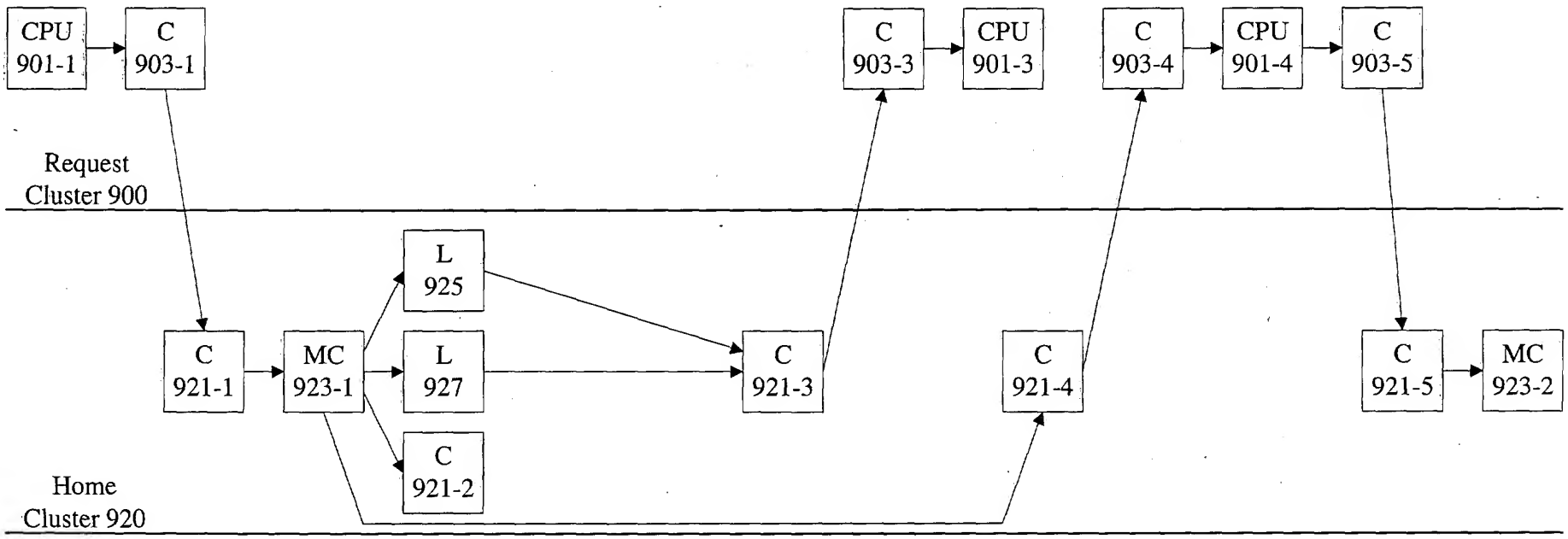

CPU 901-1
C 903-1
C 903-3
CPU 901-3
C 903-4
CPU 901-4
C 903-5
Request Cluster 900
L 925
C 921-1
MC 923-1
L 927
C 921-3
C 921-4
C 921-5
MC 923-2
C 921-2
Home Cluster 920

Figure 10

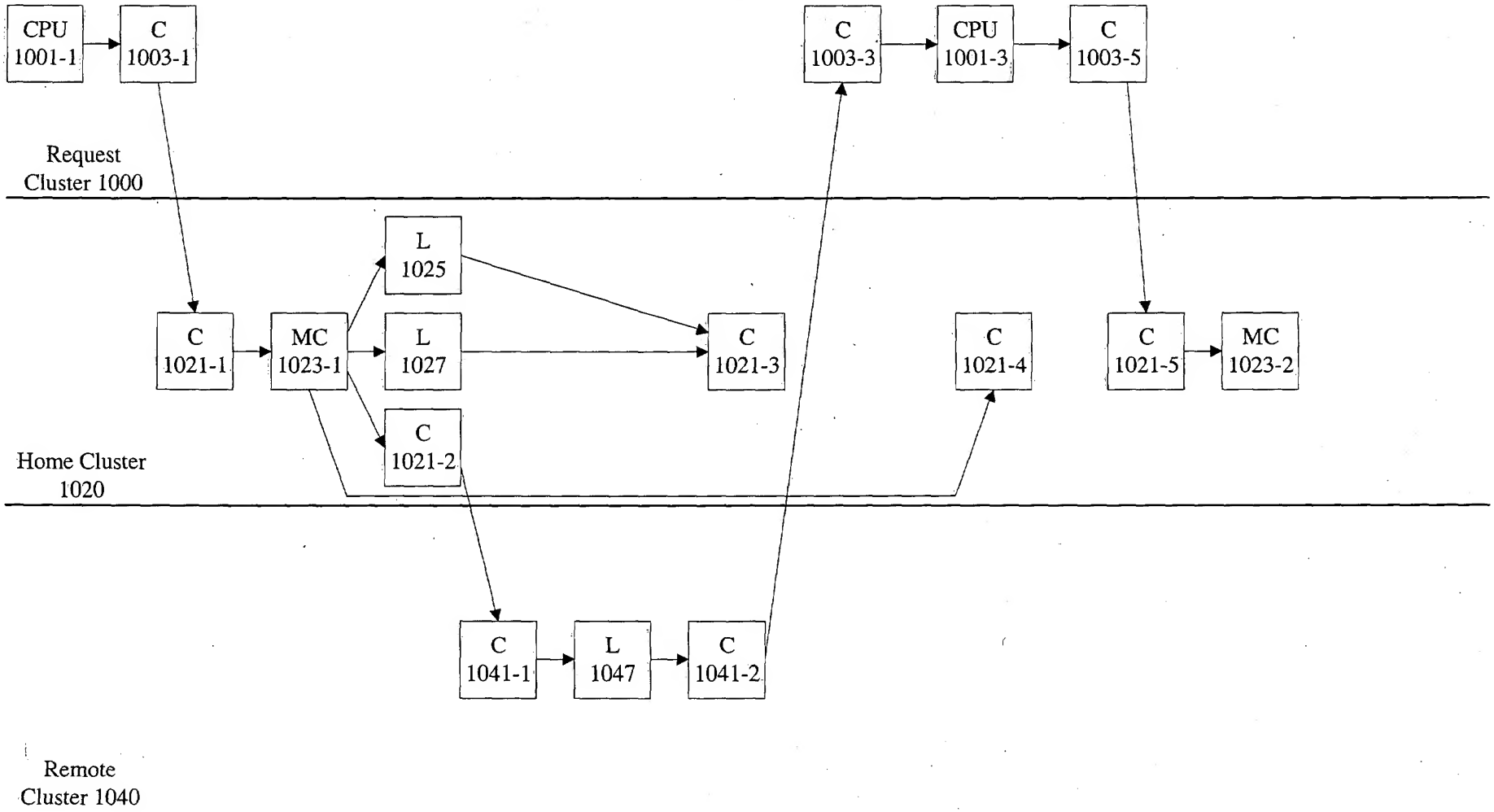

CPU 1001-1
C 1003-1
C 1003-3
CPU 1001-3
C 1003-5
Request Cluster 1000
L 1025
C 1021-1
MC 1023-1
L 1027
C 1021-3
C 1021-4
C 1021-5
MC 1023-2
C 1021-2
Home Cluster 1020
C 1041-1
L 1047
C 1041-2
Remote Cluster 1040

Figure 11

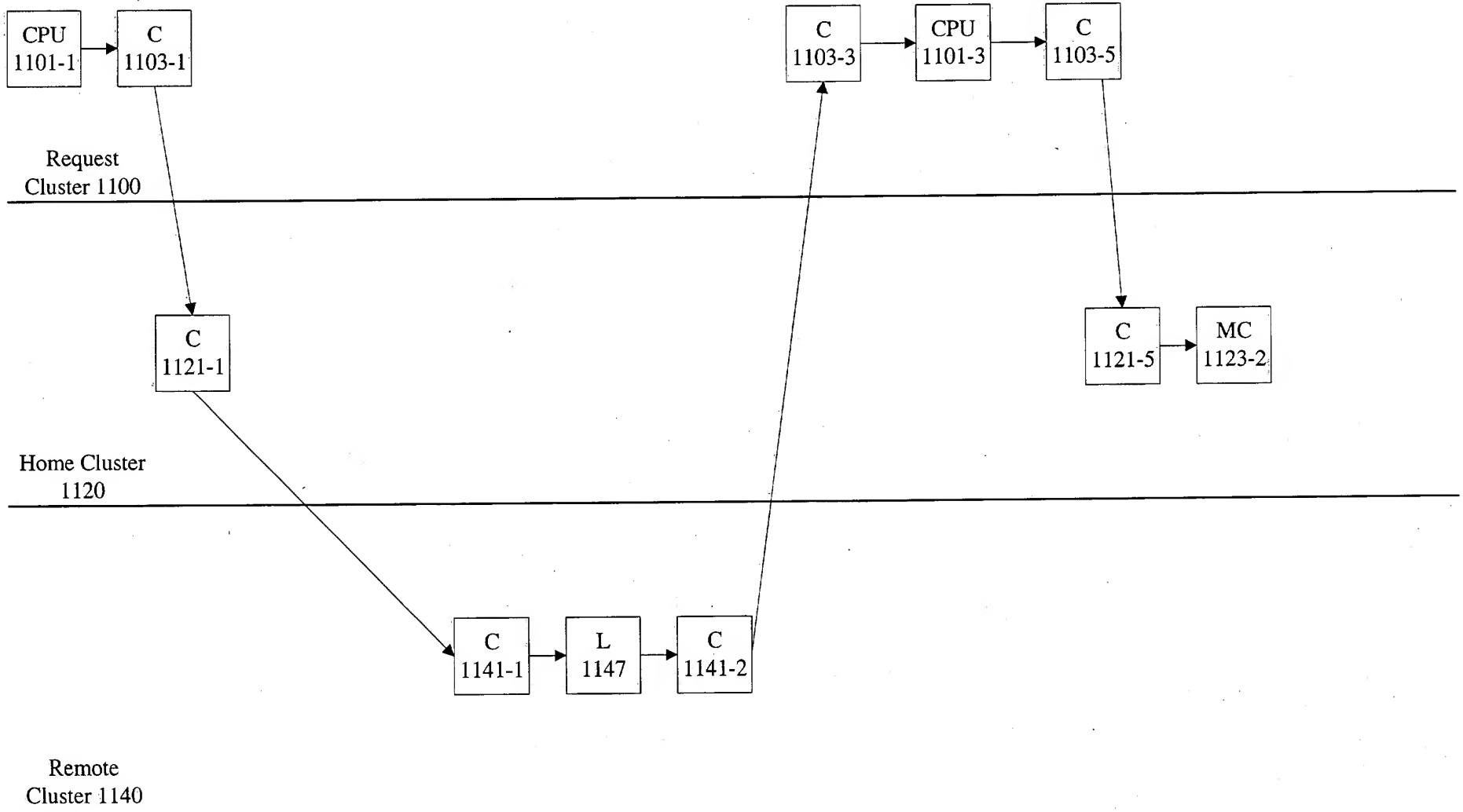
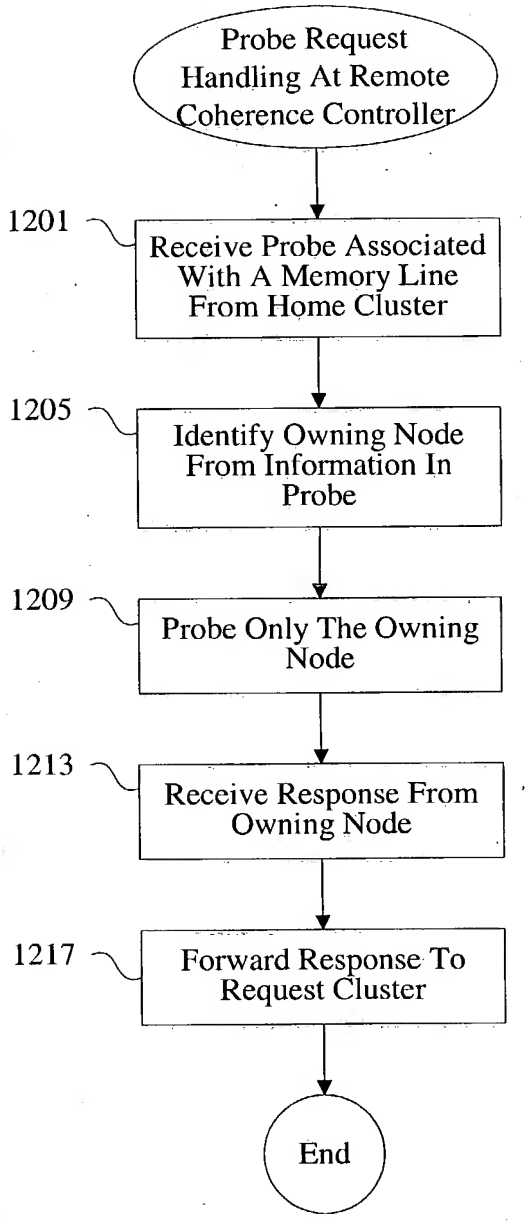

CPU 1101-1
C 1103-1
C 1103-3
CPU 1101-3
C 1103-5
Request Cluster 1100
C 1121-1
C 1121-5
MC 1123-2
Home Cluster 1120
C 1141-1
L 1147
C 1141-2
Remote Cluster 1140

Figure 12


Probe Request Handling At Remote Coherence Controller
1201
Receive Probe Associated With A Memory Line From Home Cluster
1205
Identify Owning Node From Information In Probe
1209
Probe Only The Owning Node
1213
Receive Response From Owning Node
1217
Forward Response To Request Cluster
End